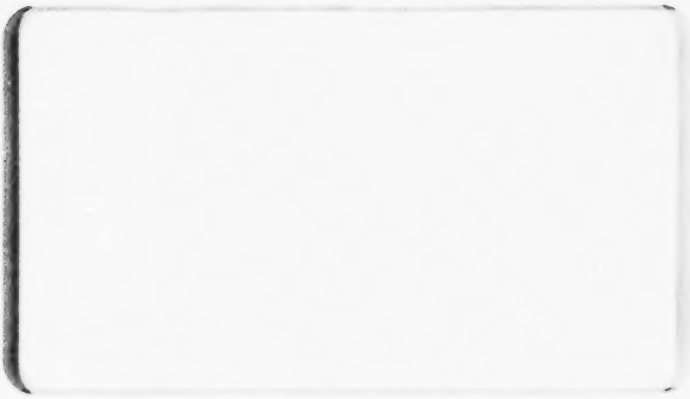
Water Resources



Alberta
ENVIRONMENT

Little Bow River
Basin Study

PHASE II -

INVENTORY OF REPORTS

LITTLE BOW RIVER BASIN STUDY
PHASE II: INVENTORY OF REPORTS

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INVENTORY REPORT

LITTLE BOW RIVER BASIN STUDIES PHASE II: SUMMARY REPORT ON STORAGE FEASIBILITY INVESTIGATIONS

Alberta Environment, Planning Division, October 1986

The Phase I report on water management in the Little Bow River Basin (June, 1985) concluded that storage development in the basin would be the most appropriate means of securing water supplies for existing licencees and for expanding irrigation development. The Phase I study called for completion of feasibility investigations to establish the most advantageous location and size of storage development.

This (Phase II) report summarizes the results of the storage feasibility study and assesses various options for future water management. The study confirms that storage development would provide a secure water supply to meet existing irrigation and municipal needs, allow considerable irrigation expansion and, at the same time, permit higher instream flows along the lower reaches of the Highwood River to improve fish habitat and water quality conditions over those of recent years.

Site 7B-1 on the Little Bow River downstream of the confluence with Mosquito Creek is the preferred location for storage development considerating engineering, economic, social and environmental factors. Three sizes of storage development at Site 7B-1 were considered - 30,000 acre-feet, 50,000 acre-feet and 70,000 acre-feet. Capital costs for these storage developments are estimated to be $8.6 million, $10.5 million and $12.8 million respectively. (These cost estimates do not include relocation costs for the Little Bow Hutterite Colony and four farmsteads).

Storage development at Site 7B-1 could supply sufficient water for between 19,000 and 57,000 acres of irrigation in the Little Bow River Basin, depending on the size of reservoir, the size of the Little Bow diversion canal and the minimum flow requirement on the Highwood River. Considering agricultural benefits alone, storage development would be economically attractive for most combinations of

storage size, canal size and minimum flow considered in this study. The combinations that provide lesser agricultural benefits provide more favourable fish habitat and water quality conditions in the Highwood River. There is strong local support for development of a large storage reservoir at Site 7B-1. Storage development would have no major negative environmental impacts.

Deliberations on the appropriate size of storage development should consider available funds, the level of irrigation expansion desired, the minimum flow requirement on the Highwood River and the possibility of upsizing the Little Bow Canal at some future date.

A Local Advisory Committee provided valuable input in the conduct of this feasibility study. The Committee would be a useful vehicle for further input and public liaison for follow-up activities if implementation of the project proceeds.

ECONOMIC REPORT

LITTLE BOW RIVER BASIN: ECONOMIC & FINANCIAL ANALYSIS OF IRRIGATION DEVELOPMENT

Marv Anderson & Associates Limited, April 1986

The overall objective of this study was to determine the economic and financial feasibility of developing additional storage to augment water supplies for irrigated agriculture in the Little Bow River Basin. Ten potential water storage options were considered.

The study focuses exclusively on the anticipated benefits to agriculture.

The basic results indicate that the benefit-cost ratios are generally well above unity while the accompanying net present values are generally positive. Two sites, however, appear particularly good:

- Site 7B-1 with increased canal capacity
- Site LB1 with increased canal capacity.

Site 7B-1, because of its relatively larger size, has the potential to generate a slightly higher net present value over the thirty year project period and for this reason might be the best option.

It appears to be particularly important that either of these developments be accompanied by additional canal capacity.

The accompanying socio-economic analysis indicates that when regional/provincial spinoffs from more intensive agricultural operations in the basin are also considered, the provincial benefit-cost ratios should almost double, while the respective (direct + indirect) net present values would probably be four or five times as large as the direct net present values.

ENVIRONMENTAL/SOCIAL REPORTS

LOCAL CONCERNS ASSESSMENT OF THREE POTENTIAL RESERVOIR SITES IN THE LITTLE BOW RIVER BASIN

Beak Associates Consulting Ltd., May 1986

This report documents and discusses the results of 47 landowner interviews regarding the construction and development of a reservoir on or near their land. This information was used in conjunction with engineering feasibility studies and an environmental overview to select the most suitable reservoir site.

The results of these interviews are listed under the following categories:

1. Background Information
2. Potential Impacts
3. Landowner Views
4. Reservoir Use
5. Project Implementation

The rating system used to compare physical impacts showed that there could be three times as many landowner impacts at Site 7B-1 and 7A as Site LB1. The most important issues were the total number of individuals affected and the number of potentially flooded buildings, improvements and land.

On the basis of the rating system used to compare landowner attitudes, it appeared that landowners at Site LB1 had a negative attitude towards reservoir construction that was equal in magnitude but opposite to the positive attitude of landowners at Site 7B-1 and 7A. This was largely attributed to a general perception by the majority of landowners at all three sites that only the larger reservoirs would store enough water to significantly improve irrigation potential and provide substantial net benefits to the community. Important issues included attitude towards reservoir construction in principle, attitude towards reservoir construction nearest the landowners, and acceptable types and levels of recreation development.

The combined results of the two rating systems showed that while landowner impacts at Site 7B-1 and 7A would be greater than the total landowner impacts at Site LB1, landowners at the larger sites nonetheless appeared to be more in favor of having a reservoir.

ENVIRONMENTAL OVERVIEW ASSESSMENT OF FOUR POTENTIAL RESERVOIR SITES IN THE LITTLE BOW RIVER BASIN

Beak Associates Consulting Ltd., May 1986

This study represents the second phase of a three-phase environmental assessment process to select a potential water storage reservoir in the Little Bow River Basin.

For comparative purposes in the study, the environmental resources were grouped into 5 categories: soils and surficial geology, land use, water quality, fisheries, and wildlife. To determine the overall environmental impacts, and the relative difference at each site, a qualitative ranking system was derived for environmental issues judged to be critical.

The results of this assessment revealed that, on an environmental basis, the sites were all similar. Differences in direct environmental impact were related directly to the size of a potential reservoir.

The four sites were ranked as follows:

Squaw Coulee Site 2, at 14,400 acre-feet would have the least environmental impact since it is the smallest site,

Little Bow Site LB1, at 17,250 acre-feet would have an intermediate environmental impact ranking due to the increased size,

Little Bow Site 7B-1 due to its larger size ranging from 50 - 70,000 acre-feet, would have a greater environmental impact when compared to the two smaller sites,

Little Bow Site 7A at 50 - 70,000 acre-feet would have an environmental impact comparable to site 7B-1.

Non-specfic data was used in preparing the major portion of this report. Since the purpose of the report is only to identify environmental impacts at each potential reservoir site, and to compare alternatives, no attempt was made to weigh these impacts against costs or benefits to occur outside the study area. Further studies will be required to verify conclusions and to fill the data gaps identified by this report. In the future if site-specific data becomes available as part of any future implementation process, specific mitigation measures would be developed to diminish or eliminate negative impacts.

LOWER HIGHWOOD RIVER INSTREAM FLOW NEEDS STUDY, EXECUTIVE SUMMARY

Environmental Assessment Section, Planning Division, December 1986

The assessment of the instream flow requirements for the Highwood River for the reaches above the Squaw Coulee Diversion downstream to the confluence with the Bow River are presented in this report. The objective of the study was to provide water managers, resource managers and planners with an understanding of the physical and water quality conditions in the river and to provide preliminary recommendations for suitable minimum flows required to protect the fisheries and aquatic ecosystems of the river.

The report is based upon extensive field assessments and water quality monitoring conducted by Alberta Environment from 1983 to 1986. Fish and Wildlife Division reviewed the study program, provided fisheries management objectives for the Lower Highwood River and reported on fisheries management issues for the period 1977 through 1985.

The preliminary instream flow values discussed in the report recognize the present amounts of licensed consumptive use in the Highwood and Little Bow River systems. To fully implement the minimum flows suggested in the report will require storage of spring flows to reduce the diversion of Highwood River flows in later July and August

The instream flow values will be used to evaluate various water management alternatives in the Highwood/Little Bow Basins.

ENGINEERING REPORTS

LITTLE BOW RIVER BASIN STORAGE SITE INVESTIGATION, CONCEPTUAL DESIGN REPORT

W-E-R Engineering Ltd. in association with Thurber Consultants Ltd. and Nanuk Engineering and Development Ltd., May 1985

A basin planning study launched by Alberta Environment in 1982 strongly recommended that the feasibility of constructing storage facilities in the Little Bow River Basin be investigated.

The initial stage of this assessment, described in this report, provides conceptual reservoir analyses for comparative purposes. Previous studies identified a total of eight reservoir alternatives. A conceptual design and cost estimate was prepared for each of these sites. This enabled the selection of three primary sites for more detailed investigation to be carried out at a feasibility design level.

This summary report compares each of the eight sites from the standpoint of water supply capability, geotechnical considerations, structures layout and design, reservoir costs, land acquisition and costs of implementation. On the basis of the conceptual investigations, recommendations for subsequent pre-design studies are presented.

LITTLE BOW RIVER BASIN STORAGE SITE INVESTIGATION, FEASIBILITY DESIGN REPORT

W-E-R Engineering Ltd. in association with Thurber Consultants Ltd. and Nanuk Engineering & Development Ltd., June 1985

This report outlines the results of feasibility design studies for three reservoir alternatives, Little Bow Site LB1, Mosquito Creek Site 4 and Squaw Coulee Site 2. It describes the engineering studies carried out which confirm the technical feasibility of the three selected reservoir sites.

The report also provides hydrology, water supply, geotechnical, feasibility design and reservoir cost investigations for the sites under consideration.

The total estimated costs for the three storage alternatives are as follows:

Little Bow	Site LB1	$ 8 million
Mosquito Creek	Site 4	$ 11 million
Squaw Coulee	Site 2	$7.5 million

The report recommends that Little Bow and Squaw Coulee sites be considered for future implementation and Mosquito Creek Site 4 be deleted from further study.

LITTLE BOW RIVER BASIN STORAGE SITE INVESTIGATION, CONFLUENCE SITES CONCEPTUAL DESIGN REPORT

W-E-R Engineering Ltd. in association with Thurber Consultants Ltd. and Nanuk Engineering & Development Ltd., August 1985

This interim report describes the results of conceptual studies conducted on three reservoir locations below the junction of Mosquito Creek and the Little Bow River. The suitability of these potential reservoirs as supply sources for highline irrigation canals has also been evaluated in this study.

The potential reservoir sites were compared from the standpoint of water supply capability, geotechnical considerations, structure layout and design, reservoir costs, land acquisition and costs of implementation.

Storage capacity of the reservoirs range from 40,000 to 50,000 acre-feet, while cost estimates range from $11 to $13 million.

Based on the results of this conceptual design study, Site 7B-1 was been selected for the feasibility investigation.

LITTLE BOW RIVER BASIN STORAGE SITE INVESTIGATION, CONFLUENCE SITE 7B-1 FEASIBILITY DESIGN REPORT

W-E-R Engineering Ltd. in association with Thurber Consultants Ltd. and Nanuk Engineering & Development Ltd., September 1985

This report outlines the results of feasibility design studies undertaken for three reservoir alternatives of 30, 50 and 70 thousand acre-feet at Little Bow Site 7B-1.

Specifically, the report describes the engineering studies carried out which confirm the technical feasibility of the three storage sizes selected at the reservoir site, 7B-1. It also provides hydrology and water supply, geotechnical, feasibility design and reservoir cost investigations for the storage under consideration.

The feasibility of the three reservoir sizes as a potential source of water supply for highline irrigation canals has also been considered in this investigation.

Each of the three reservoir sizes at Site 7B-1 are compared on the basis of water supply capability, geotechnical considerations, structure layout and design, reservoir costs, land acquisition and costs of implementation.

The report recommends that a reservoir storage capacity in the range of 50,000 to 70,000 acre-feet be considered for implementation at an estimated cost of $10.5 million and $12.83 million respectively, not including building relocation costs.

HYDROGEOLOGICAL EVALUATION OF THE LITTLE BOW RIVER SITE 7B-1

Piteau Engineering Ltd., November 1985

A very preliminary assessment of the hydrogeological setting of the proposed reservoir is described in this report. The proposed location of the Little Bow River Dam 7B-1 is approximately 2 km downstream of the Little Bow River/Mosquito Creek junction.

Water impounded in the reservoir would be of better chemical quality than the local groundwater. Therefore, the introduction of this water would probably be beneficial to shallow groundwater in the area. Groundwater chemistry would also be affected by the cyclic aeration and saturation of soil or upper bedrock due to the lowering and raising of the reservoir level. Such fluctuations may increase metal concentrations in groundwater. However, these fluctuations would be limited to areas adjacent to the reservoir. Also, as most domestic wells are completed deeper in bedrock, any adverse affects would likely be minimal.

In general, the groundwater surface elevation in the valleys was at or near the ground surface. On the uplands, surface water was rarely observed except for local ponding in shallow depressions. Flooding does not appear to be a concern due to the high ground surface elevations of areas bordering the reservoir.

There is not enough data at present to determine groundwater seepage losses through the valley walls and bottom. However, it is anticipated that any water losses would likely be primarily through the valley bottom.

This study does not consider slope stability concerns, possible effects of the proposed reservoir on an earthfill dam, or seepage through the dam foundations and abutments. For more detail on these issues, refer to feasibility design reports.

LITTLE BOW RIVER BASIN STORAGE SITE INVESTIGATION, SITE 7A,
FEASIBILITY DESIGN REPORT

W-E-R Engineering Ltd. in association with Thurber Consultants Ltd., March 1986

This report outlines the results of feasibility design studies undertaken for the reservoir storage sizes of 50,000 and 70,000 acre-feet at Little Bow Site 7A.

This study was conducted at the request of the Local Advisory Committee. The study included a test hole program (seven rotary drill holes) adequate to confirm foundation conditions and reservoir integrity for planning purposes.

This report describes the engineering studies carried out to determine the technical feasibility of the two storage levels at Little Bow Site 7A. It also provides hydrology and water supply, geotechnical, feasibility design and reservoir cost investigations for the storage alternatives under consideration.

The total estimated costs for the two reservoir storage sizes are: 50,000 acre-feet storage capacity, $21 million and, 70,000 acre-feet storage capacity, $25 million.

The investigation identifies seepage control as a major problem at Site 7A due to significant depths of relatively pervious soils at the site. Consequently, Site 7A has not been recommended for implementation.

LITTLE BOW RIVER BASIN PHASE II PLANNING ACTIVITIES - ANALYSIS OF WATER SUPPLY ALTERNATIVES

Nanuk Engineering, April 1986

This water balance study was conducted utilizing a computer simulation model and examined a wide range of alternatives for improving the water supply system and increasing the potential for irrigation development in the basin. These simulations were undertaken to determine the irrigation acreage that could be supported in the three major reaches with several values of minimum flow in the Highwood River. The alternatives included:

1. Increased diversion capacity
2. Water storage at several onstream sites
3. Clear Lake Project
4. Combinations of the above

Water requirements in the Little Bow Basin consisted of a municipal and riparian flow of 15 cfs and irrigation usage which was set a 1.5 acre-feet/acre with 1.0 acre-feet/acre available for irrigation withdrawal and 0.5 acre-feet/acre for spills, conveyance and losses. Natural runoff and reservoir evaporation were included in the analysis of onstream storage alternatives. The water requirements were tested against the water supply available through various diversion and storage schemes using historic, daily, natural flow in the Highwood River from 1909 to 1985. The reliability criteria applied to water supply was essentially a 90% probability that seasonal water requirement will be satisfied with maximum monthly deficits less than prescribed values.

The report provides information on effect of enlargement of the two diversion canals, an evaluation of five potential reservoir sites, and water supply analysis for the Clear Lake Project.

WATER BALANCE STUDY OF THE LITTLE BOW RIVER BASIN AND HIGHWOOD DIVERSIONS

Nanuk Engineering and Development Ltd., December 1986

This report describes the simulations of the Highwood River - Little Bow River Basin water balance model conducted in the fall of 1986. These simulations were undertaken to determine the irrigation acreage that could be supported from a reservoir at the confluence site (7B-1). A total of eighteen (18) scenarios were evaluated for various combinations of storage size, canal capacity and minimum flow requirements for the Highwood River as follows:

Storage size:	30,000, 50,000 and 70,000 acre feet
Canal capacity:	Squaw Coulee Canal - 60 cfs Little Bow Canal - 100 cfs and 300 cfs
Highwood River minimum flows:	70 cfs, 250 cfs and fisheries derived minimum flows which are seasonally variable

The present level of licensed irrigation use upstream of Site 7B-1 was assumed, and flows for municipal use and channel losses were provided in all scenarios.

The report summarizes and compares output data from all model simulations. Flows in the Highwood River above and below High River, flows to Travers Reservoir and water levels in the reservoir at 7B-1 are provided. Irrigated acreage that can be supported downstream of a reservoir at 7B-1 is estimated. Number of deficits and their magnitude are also described.